

ULTRASOUND IN SPACE MEDICINE

S. A. Dulchavsky, A.E. Sargsyan

WINFOCUS

Bologna, Italy, November 2009

ADUM

ADVANCED DIAGNOSTIC ULTRASOUND IN MICROGRAVITY

wyle
laboratories



EXPERIMENT OVERVIEW

ULTRASOUND IMAGERY

EXERCISES



OPE

QUIT ESC

VOLUME



SKIP

S

Research Goals

Determine accuracy of ultrasound in novel clinical conditions

Determine optimal training methodologies

- Determine microgravity associated changes

- Develop intuitive ultrasound catalog to enhance autonomous medical care

Ultrasound Protocols: ADUM

- Cardiac
- Abdominal
 - Spleen
 - Liver
 - Gallbladder
- Retroperitoneal
 - Kidneys
 - Pancreas
 - Abdominal Aorta
 - IVC
- Genitourinary
 - Bladder
 - Prostate
- Musculoskeletal
 - Rotator Cuff
 - Knee, Ankle, Elbow
- Thyroid
- Dental
- Sinus
- Eye
- Peripheral Vessels
 - Carotid/Jugular
 - Maneuvers
 - DVT R/O







SHIFT F1 **INTRODUCTION**

SHIFT F2 **EXPERIMENT SYNOPSIS**

SHIFT F3 **BRAIN GYM**

SHIFT F4 **ADVANCED DIAGNOSTIC
ULTRASOUND OPERATIONS**

SHIFT F5 **REMOTE GUIDANCE
TERMINOLOGY**

SHIFT F6 **ANATOMY**

SHIFT F7 **SCANNING**

CARDIAC

THORACIC

CARDIAC & THORACIC DEMOS

SHIFT F8 **ULTRASOUND EXERCISES**

SHIFT F9 **CONCLUSIONS**

SHIFT F10 **BLOOPERS**

SHIFT ↑ PREVIOUS SEGMENT

SHIFT ↓ NEXT SEGMENT

OPE v1.0

VOLUME - +

VIEW REMOTE GUIDANCE CARD SHIFT V

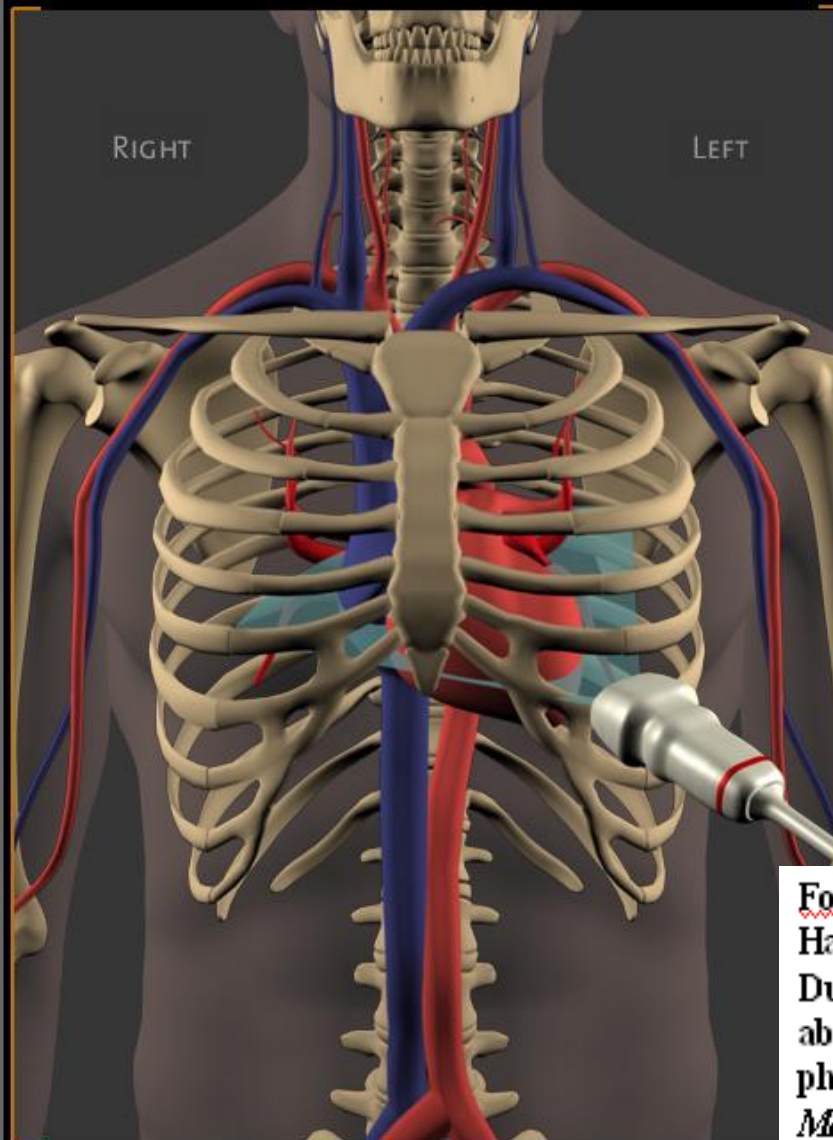
QUIT ESC SWITCH LANGUAGE SHIFT L

CARDIAC SCANNING POSITIONS

C2 1

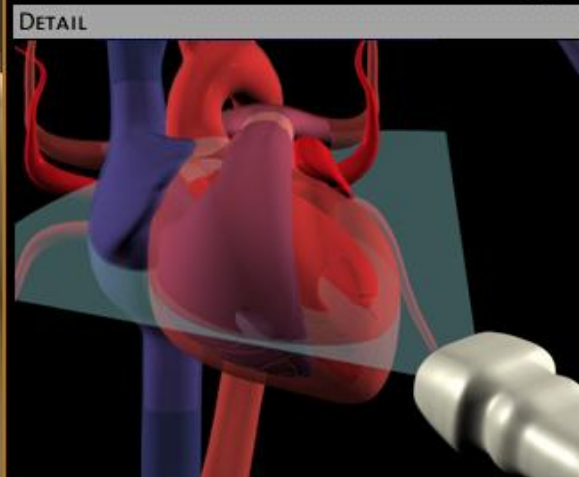
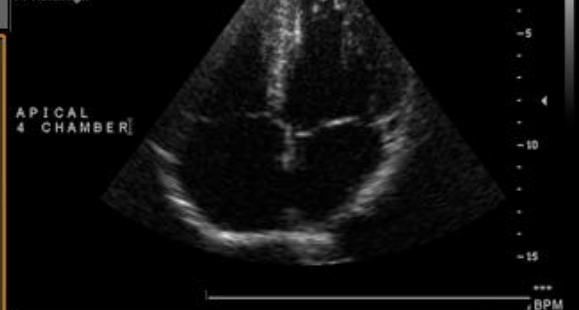
C3 2

C4 3



ULTRASOUND

ADUMTEST E003 08 Aug 03 T1s 0.0 M1 1.0
NASA Cardiac Lab P4-2 ACard/Tilt 10:35:24 am 15.4c
Map 3 170dBIC 3
Persist Low
2D OptHiRes
Fr RateHigh



POSITION DESCRIPTION

PLACE THE PROBE IN THE C2 POSITION
POINTING UPWARDS IN THE DIRECTION OF

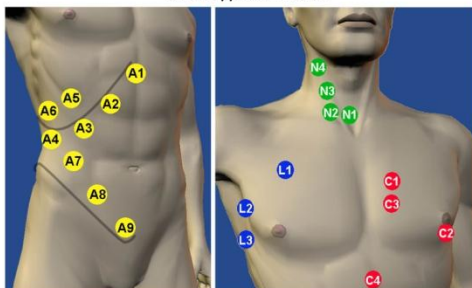
Foale CM, Kaleri AY, Sargsyan AE, Hamilton DR, Melton S, Martin D, Dulchavsky SA Diagnostic instrumentation aboard ISS: just-in-time training for non-physician crewmembers. *Aviat Space Environ Med.* 2005 Jun; 76(6):594-8.

Cue Card and Reference Image sets

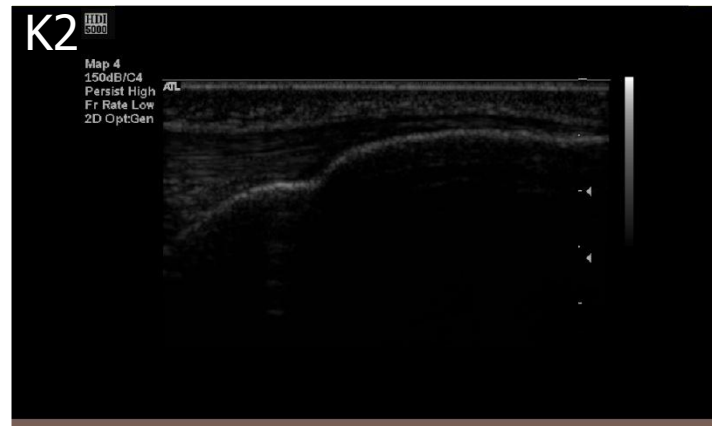
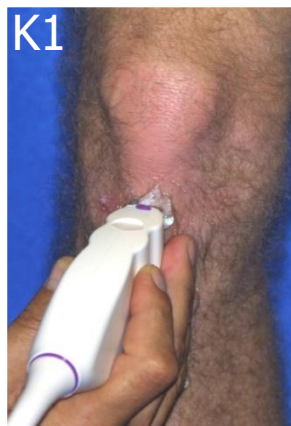
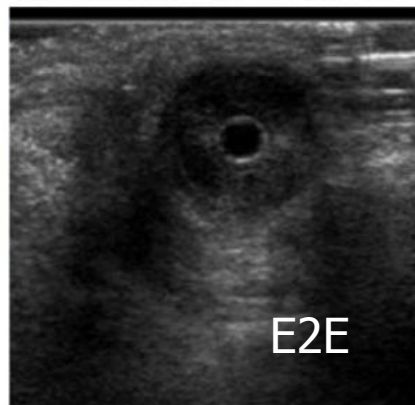
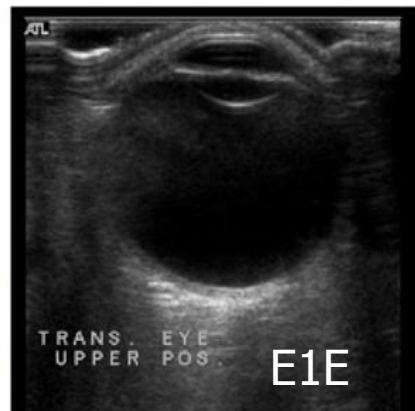
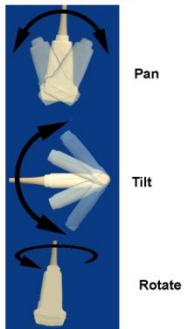
HRF Ultrasound Keyboard



Probe Application Points

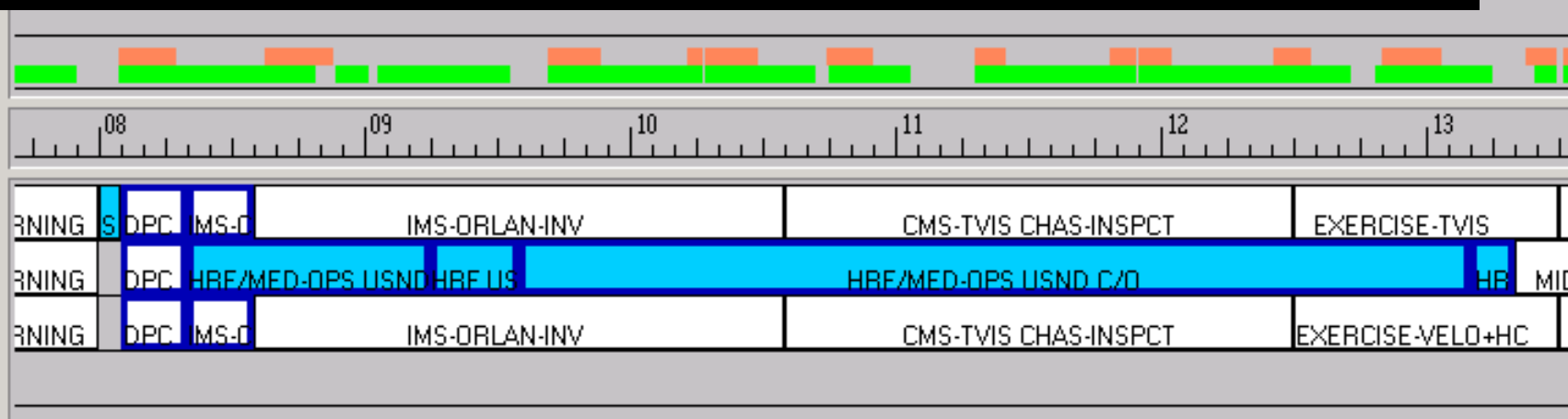


Probe Manipulation





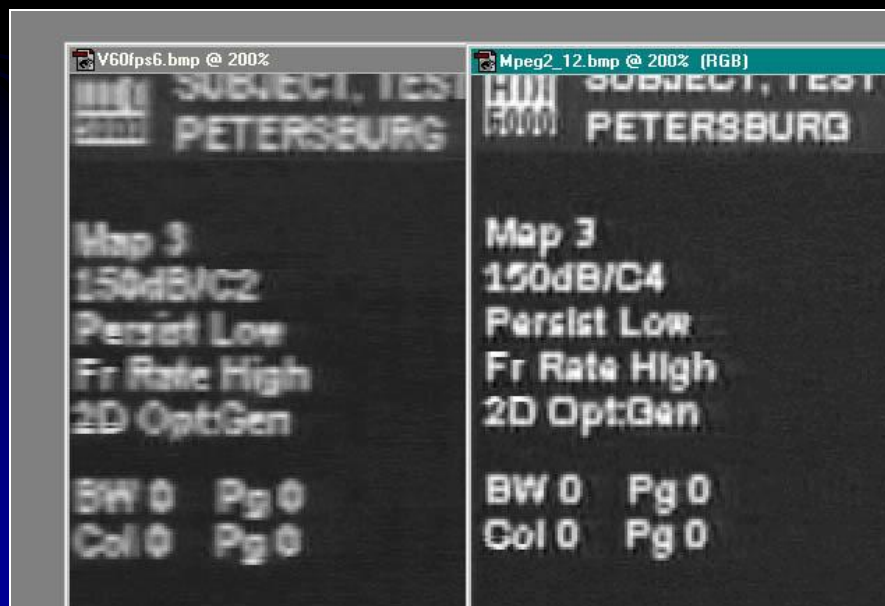
ISS Technical challenges



Ku-band = VIDEO



S-band = AUDIO



Hardware assembly / set
up time
Data transmission
Video Degradation

ISS Crewmembers in Ultrasound Operations



ISS010E25158

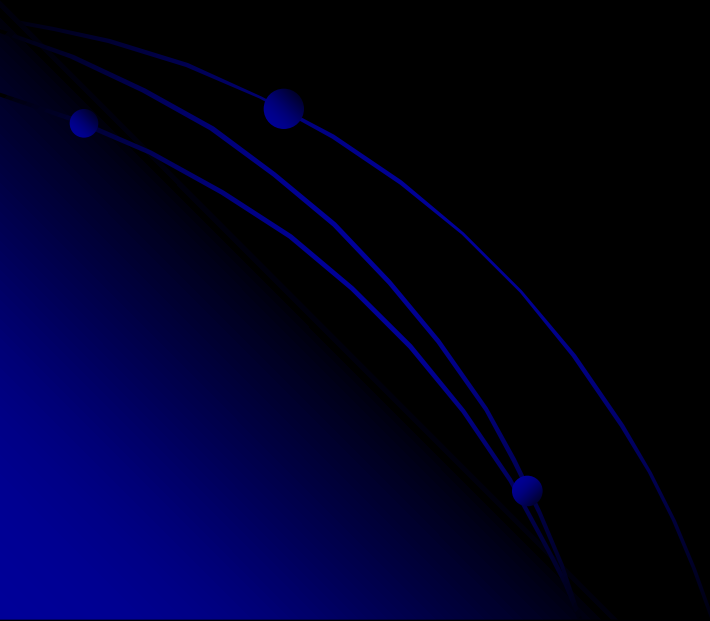
1



ISS008E22256

ADUM Crew Experience

- **Leroy Chiao:** “ADUM was the single most valuable piece of scientific and operational work that came out of my expedition”
1/09/07

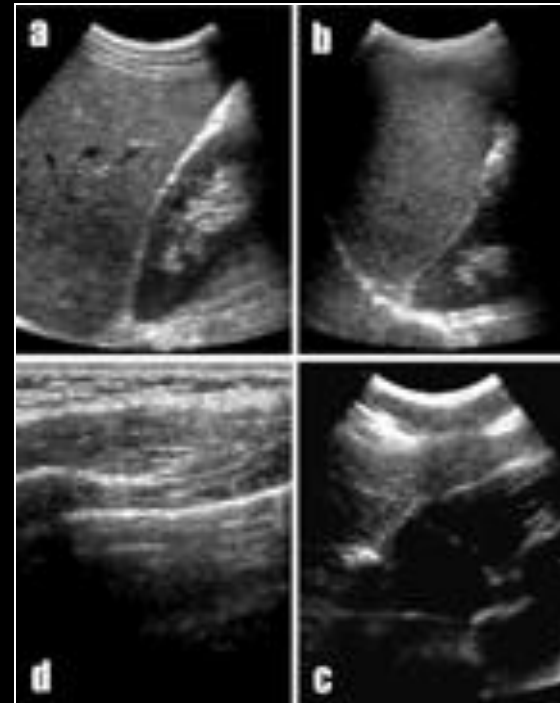


Focused Assessment with Sonography for Trauma (FAST)

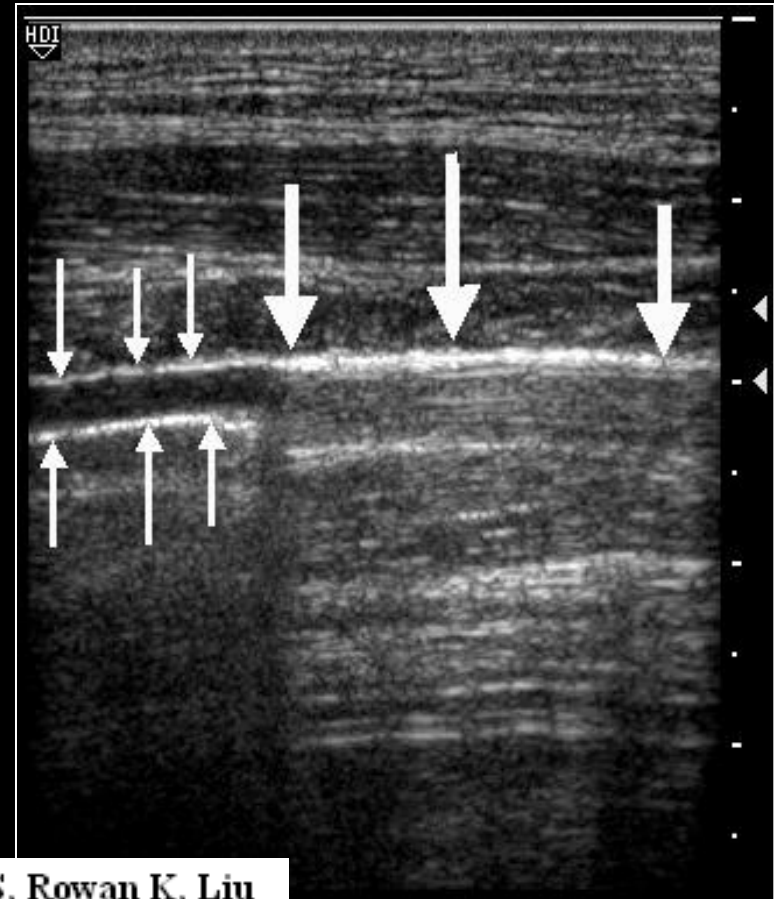
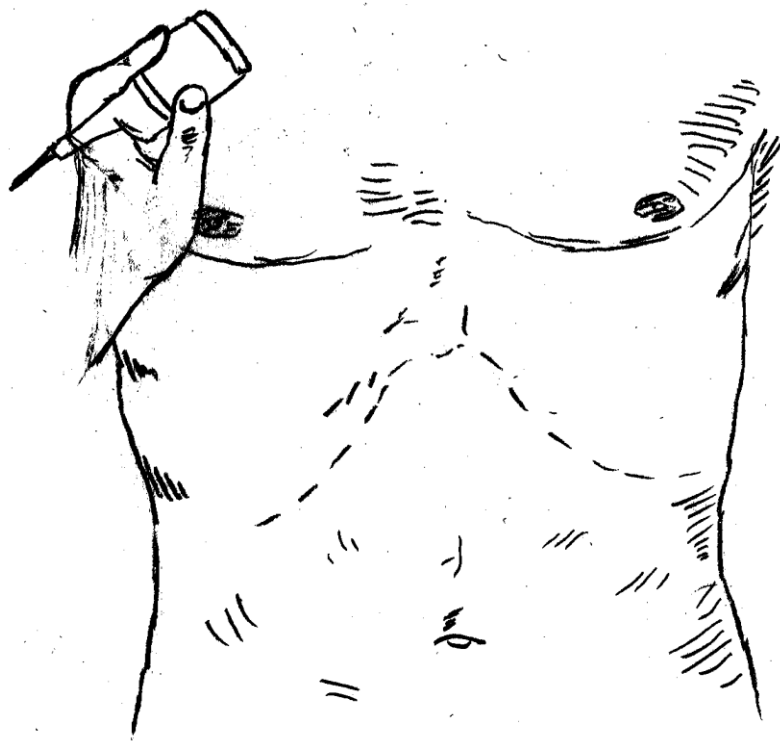


Example: FAST (Focused Assessment by Sonography for Trauma)

- Where does the fluid go?
- No “dependent” locations
- With no gravity, weaker forces come into play and determine fluid distribution



Sargsyan AE, Hamilton DR, Jones JA, Melton S, Whitson PA, Kirkpatrick AW, Martin D, Dulchavsky SA. FAST at MACH 20: clinical ultrasound aboard the International Space Station. *J Trauma*. 2005 Jan;58(1):35-9.



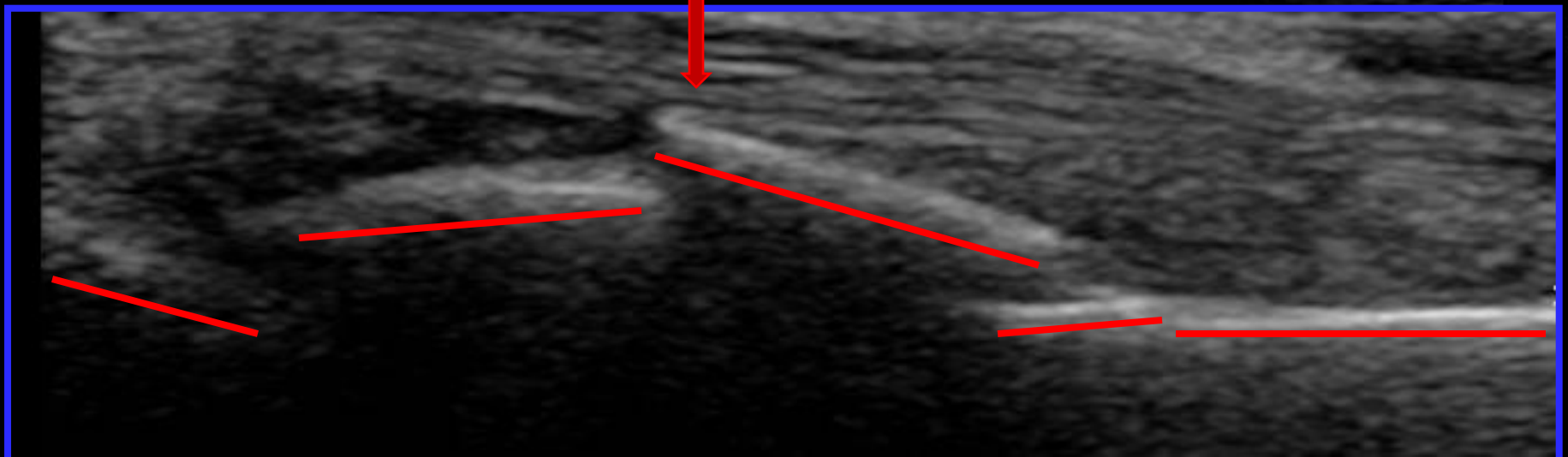
Kirkpatrick AW, Nicolaou S, Rowan K, Liu D, Cunningham J, Sargsyan AE, Hamilton D, Dulchavsky SA. Thoracic sonography for pneumothorax: the clinical evaluation of an operational space medicine spin-off. *Acta Astronaut.* 2005 May-Jun;56(9-12):831-8.

Musculoskeletal Ultrasound

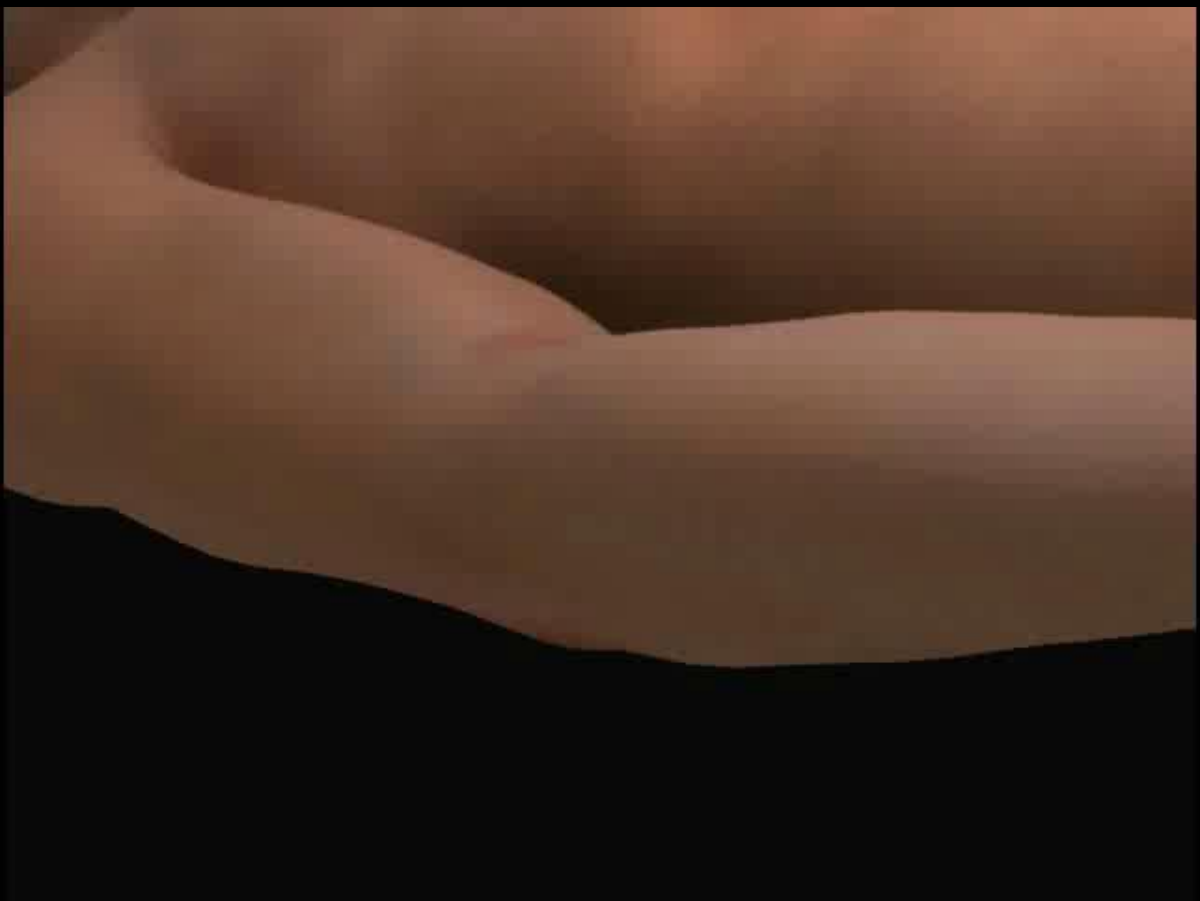
FASTER Exam

PHILIPS
BREAK
Superficial
L12-3
43Hz
3cm

2D
Res
Gn 50
C 56
3 / 3 / 3

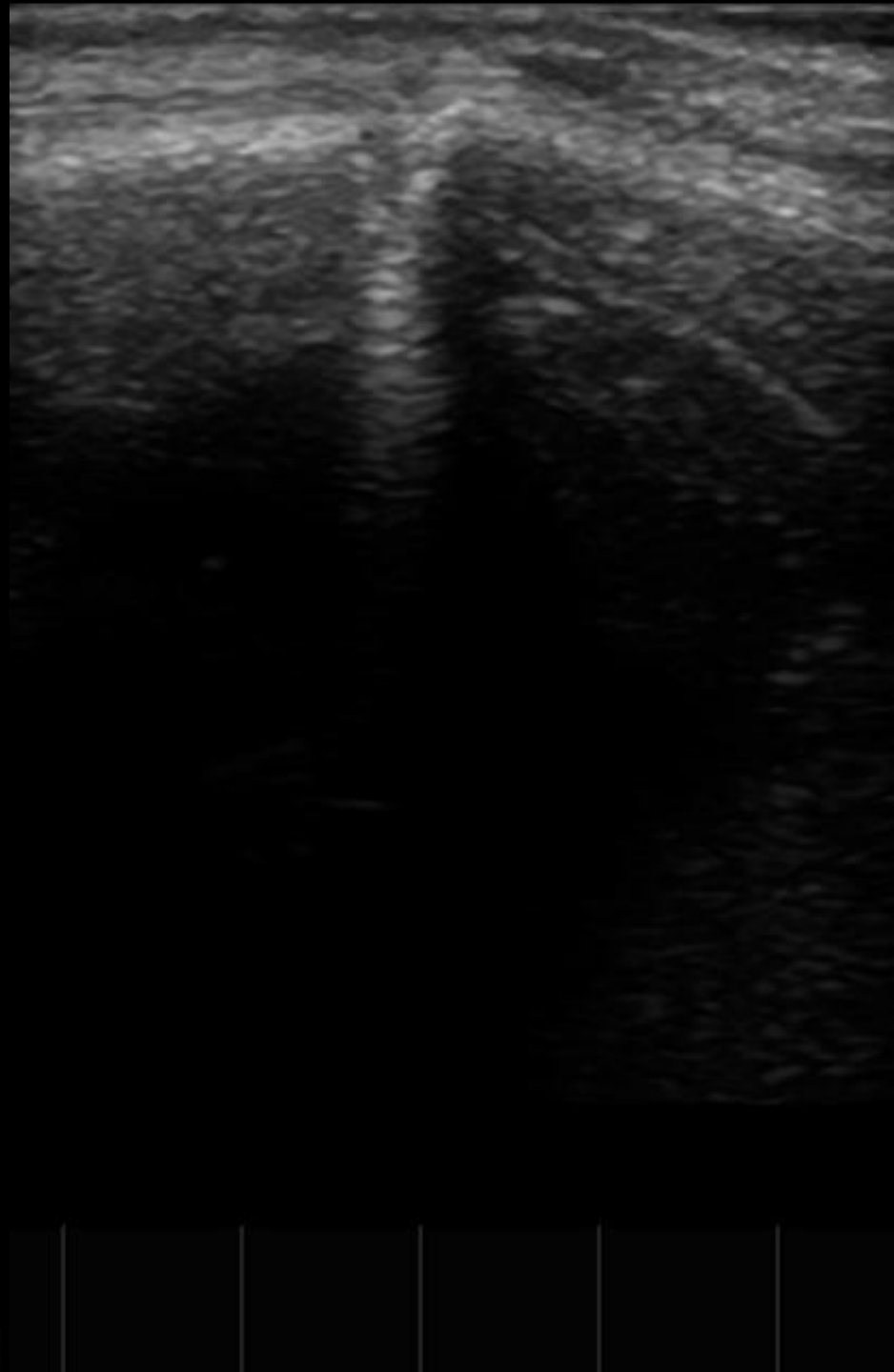


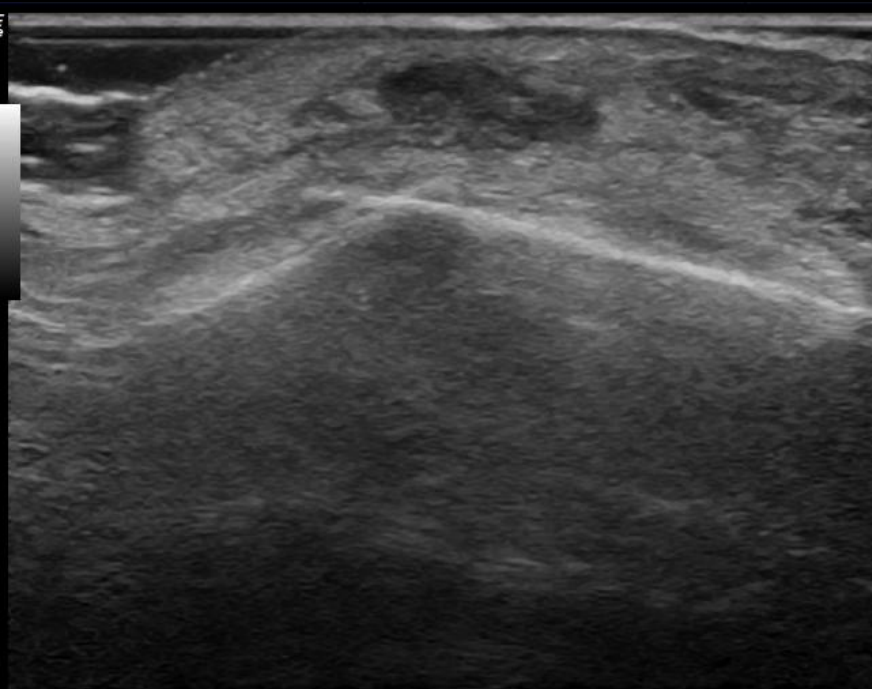
Just in time training videos



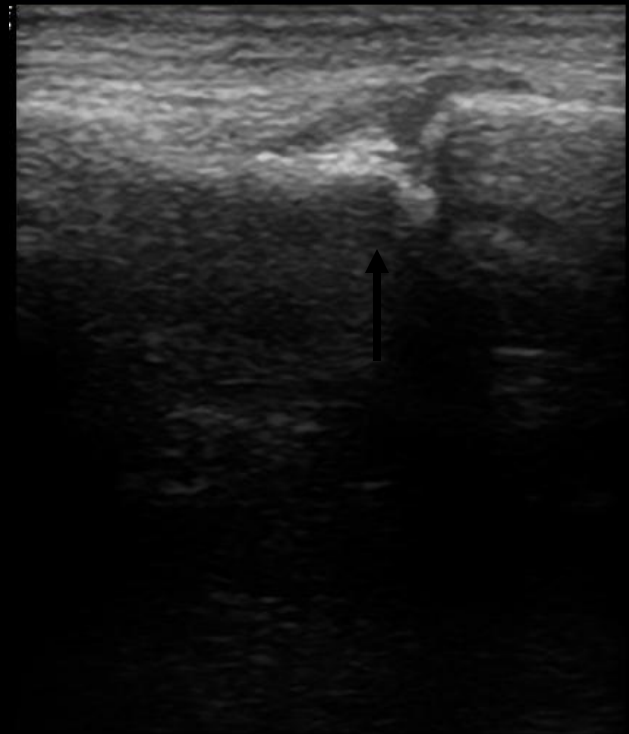


R
712





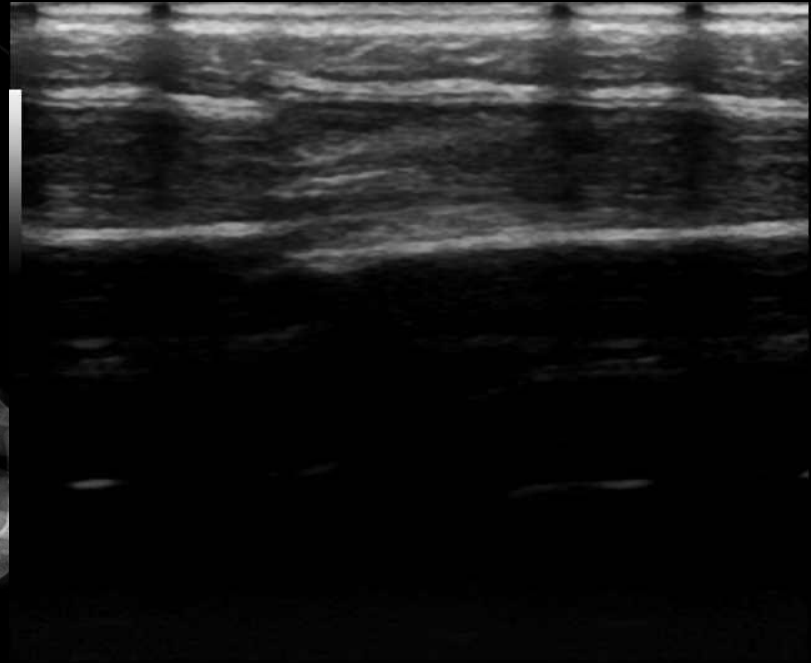
Fracture Healing

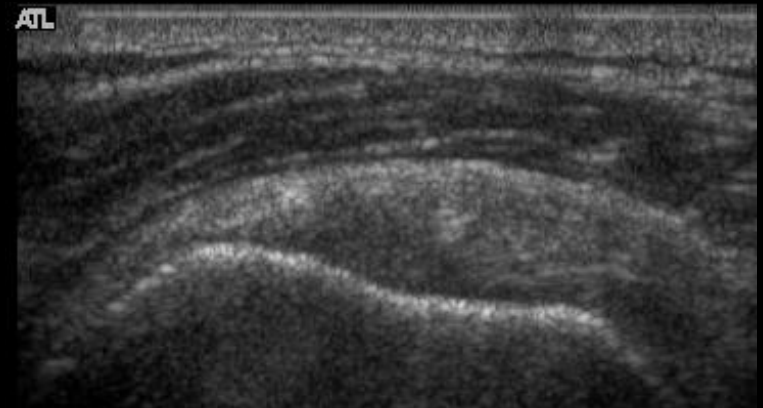


Ultrasound image of a fracture of the 5th metacarpal which also shows the callus formation around the fracture. Ultrasound image was taken 1 month after fracture.

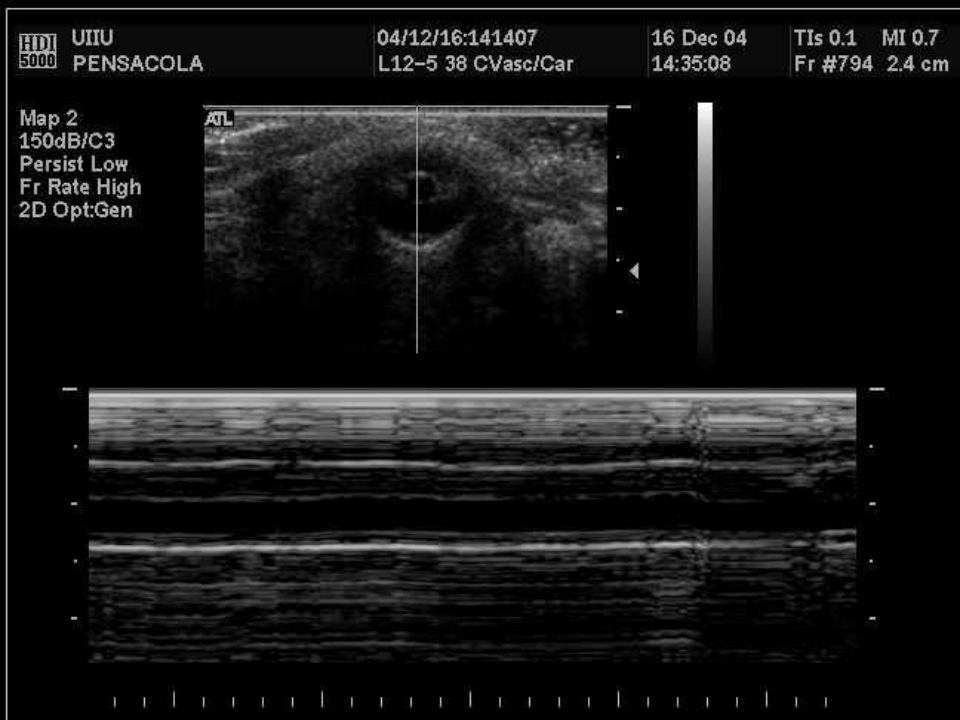
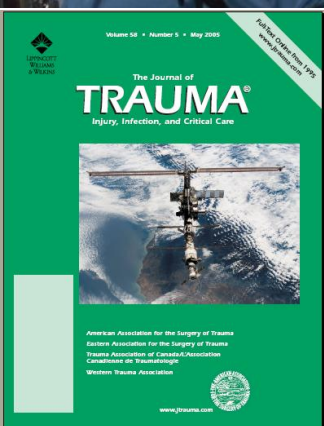


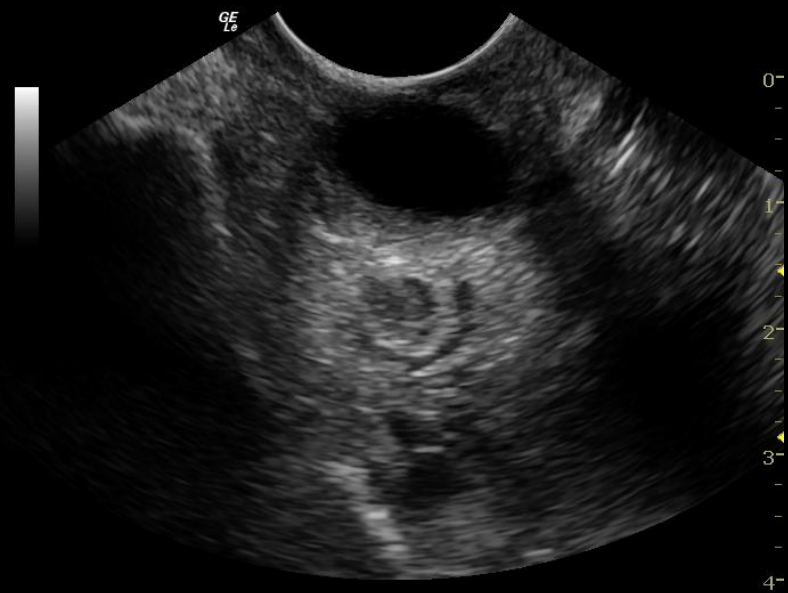
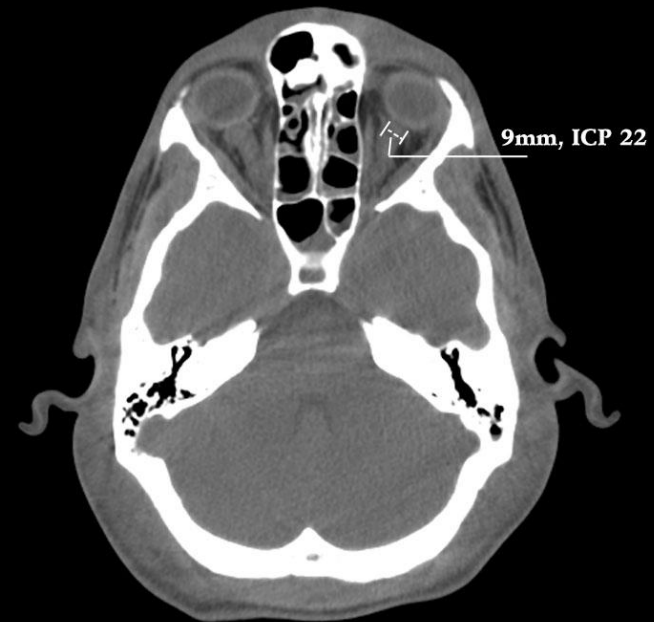
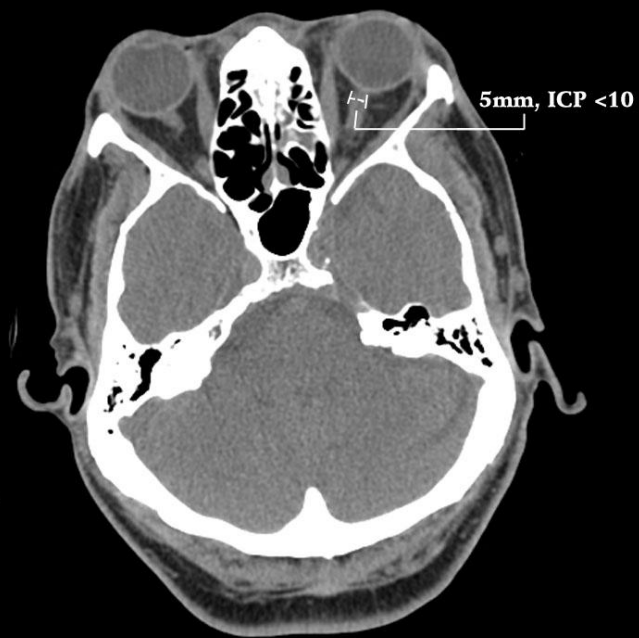
RT 268



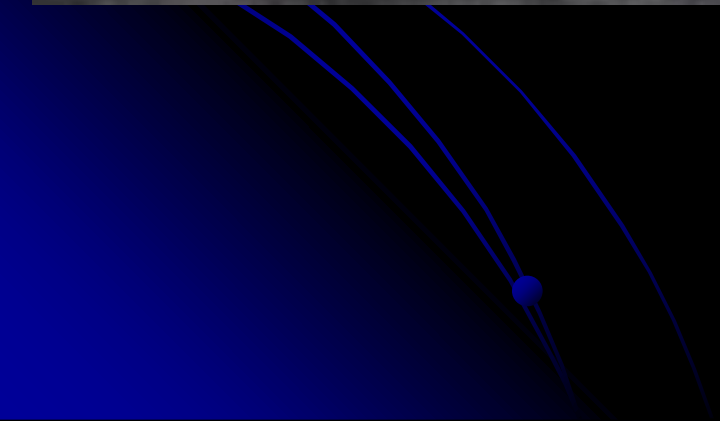
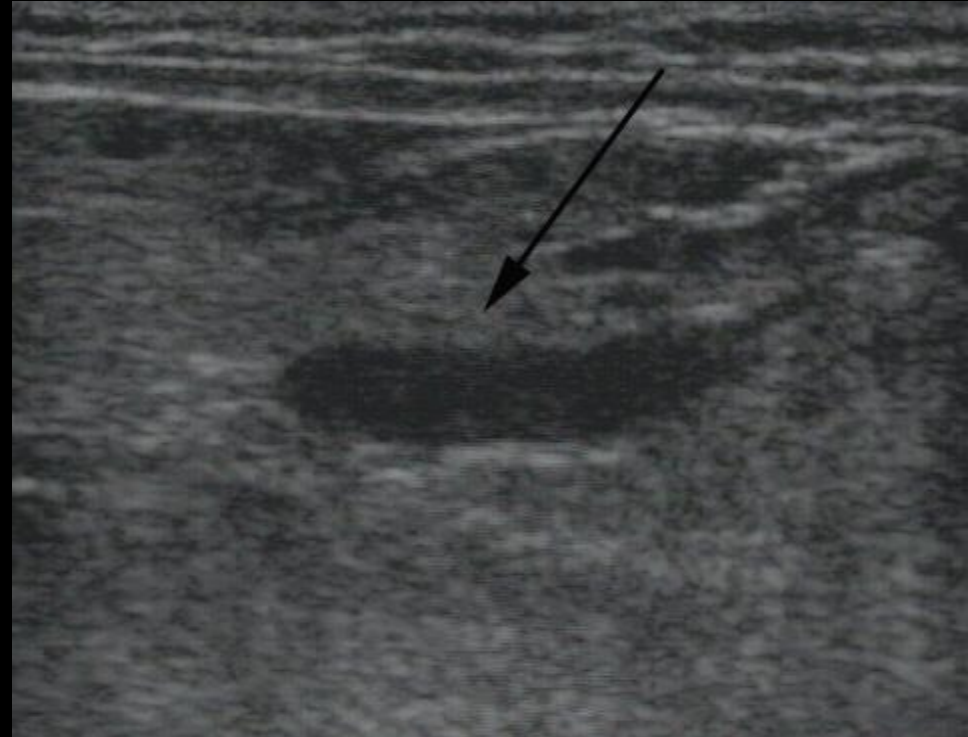
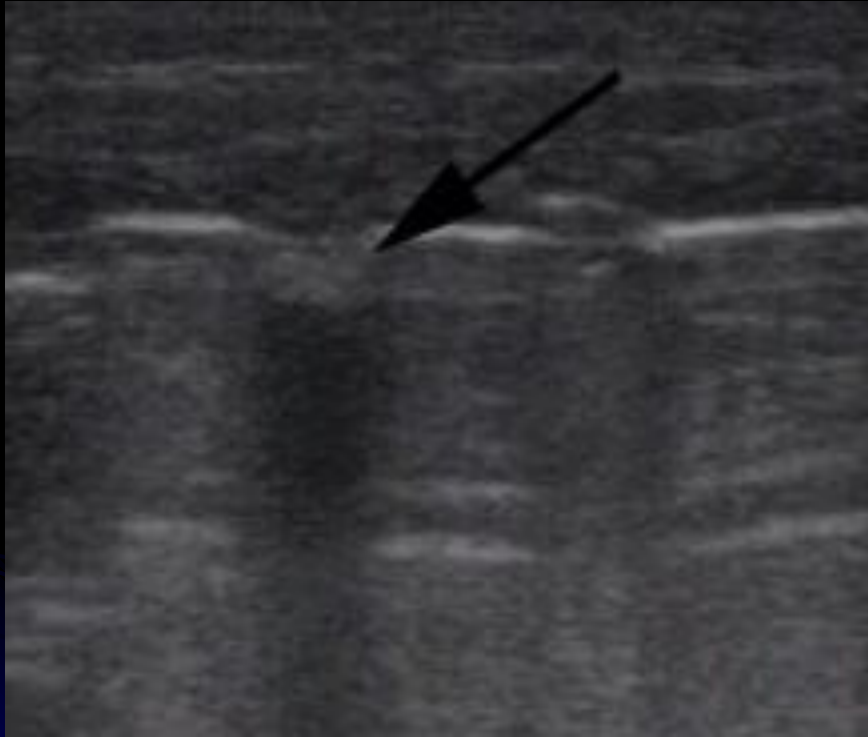


Fincke EM, Padalka G, Lee D, van Holsbeeck M, Sargsyan AE, Hamilton DR, Martin D, Melton SL, McFarlin K, Dulchavsky SA. Evaluation of shoulder integrity in space: first report of musculoskeletal US on the International Space Station. *Radiology*. 2005 Feb;234(2):319-22. Epub 2004 Nov 8.





Dental and Sinus Infections



Terrestrial Applications



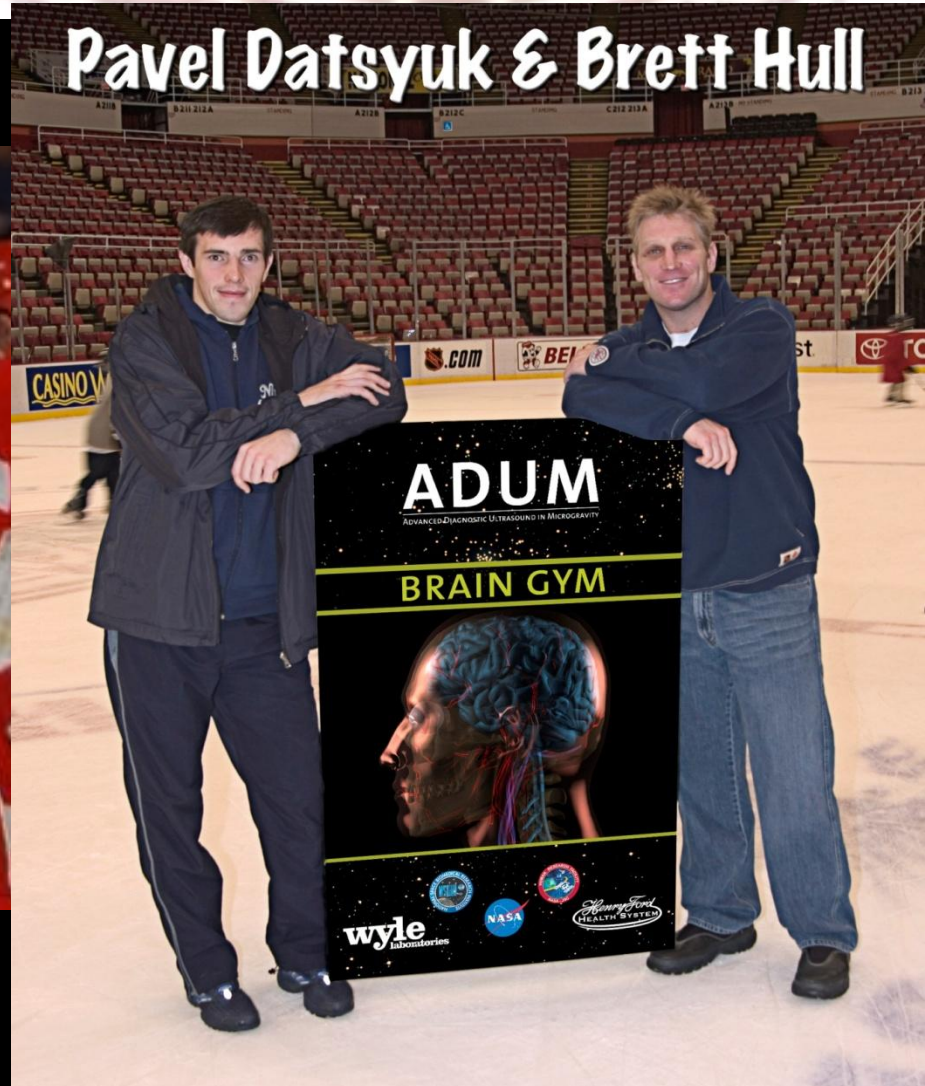


The official site of the 10-time Stanley Cup champion

Detroit Red Wings



Pavel Datsyuk & Brett Hull

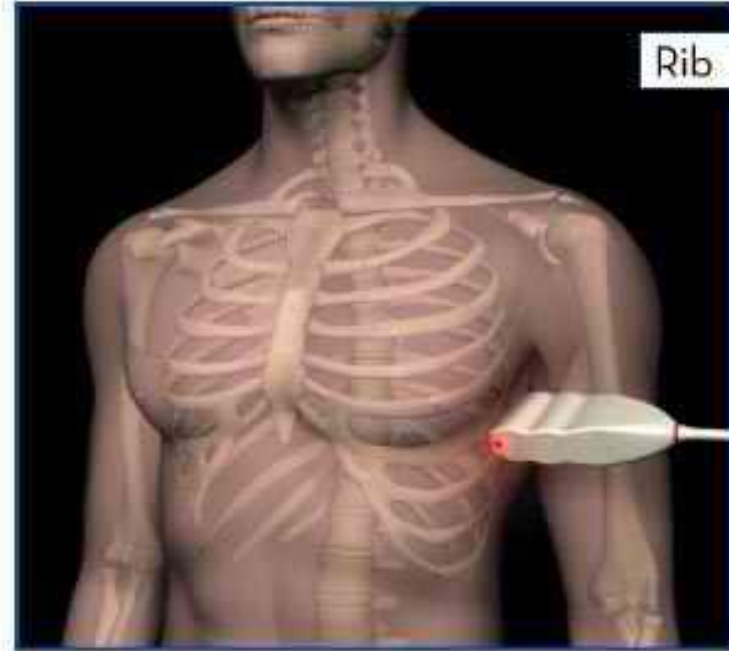


Initial Probe Positions

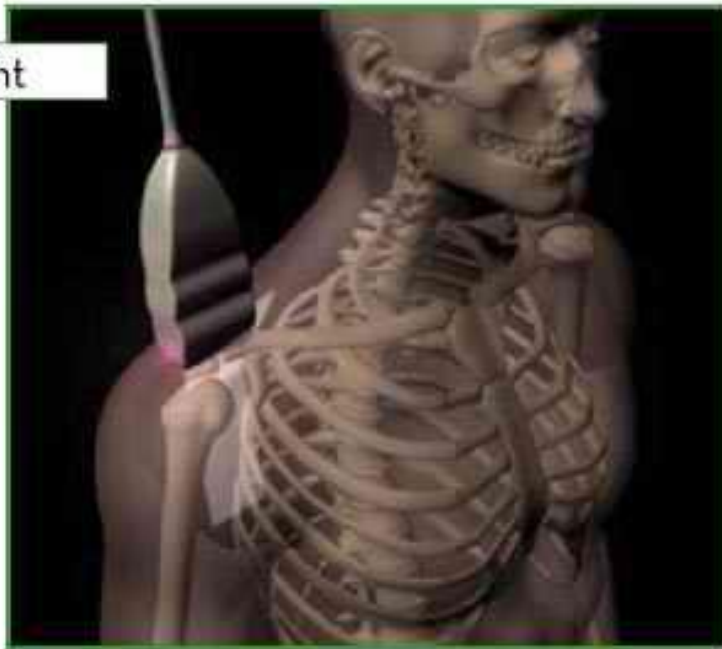
Shoulder



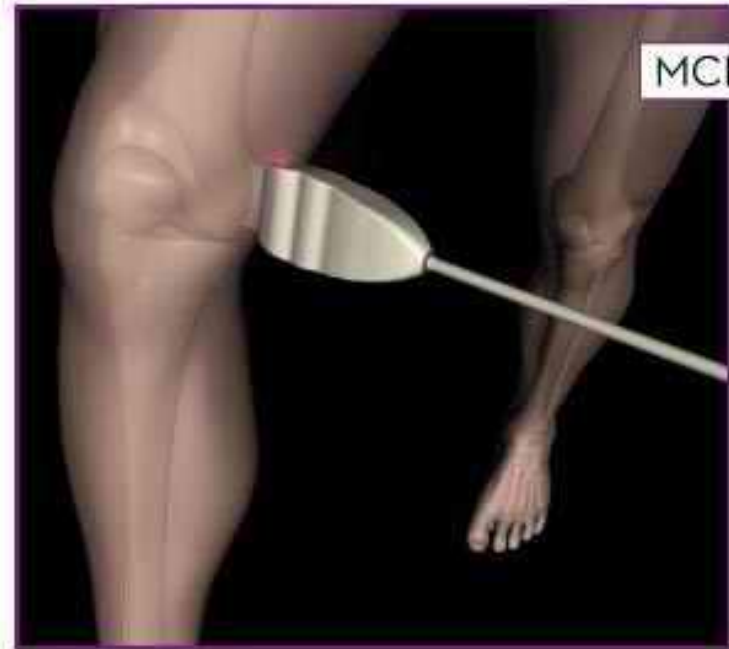
Rib

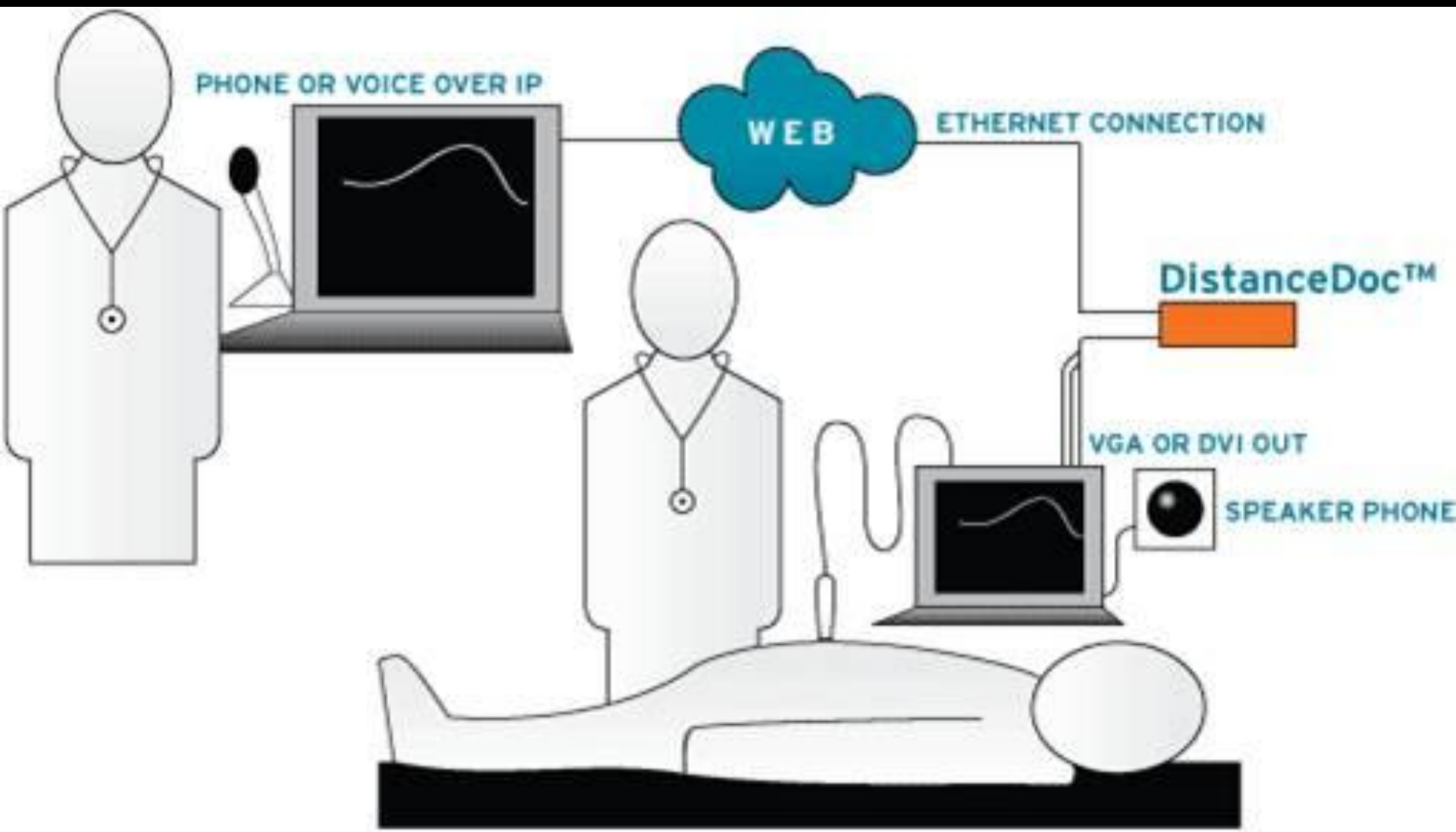


AC Joint



MCL









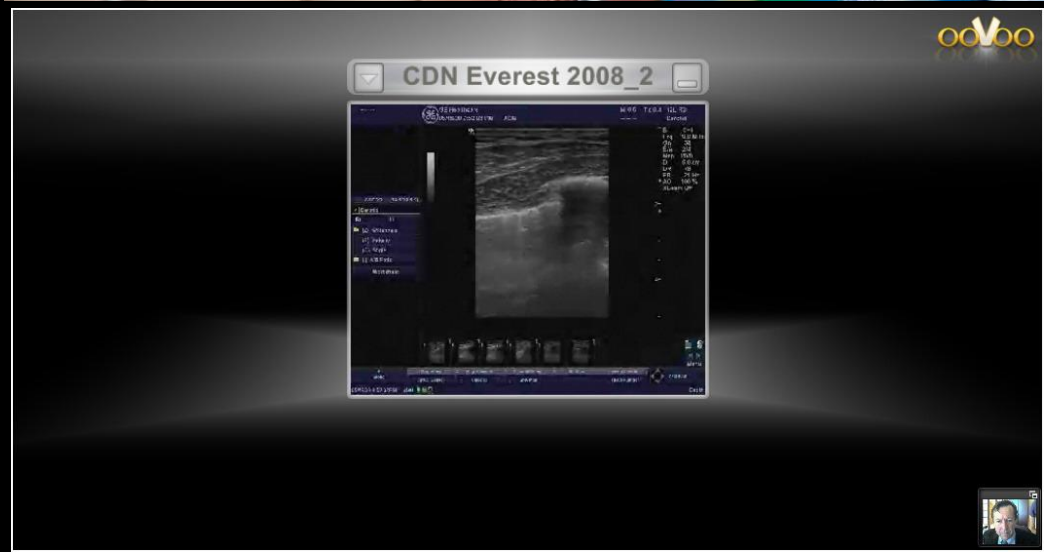
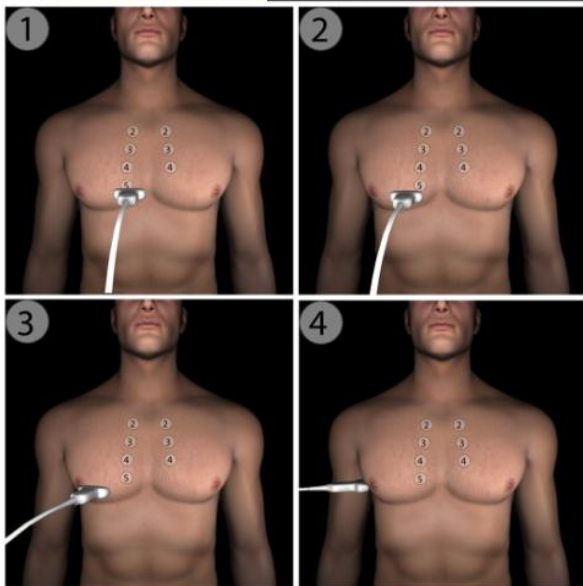
XX Olympic Winter Games
10-26 February 2006





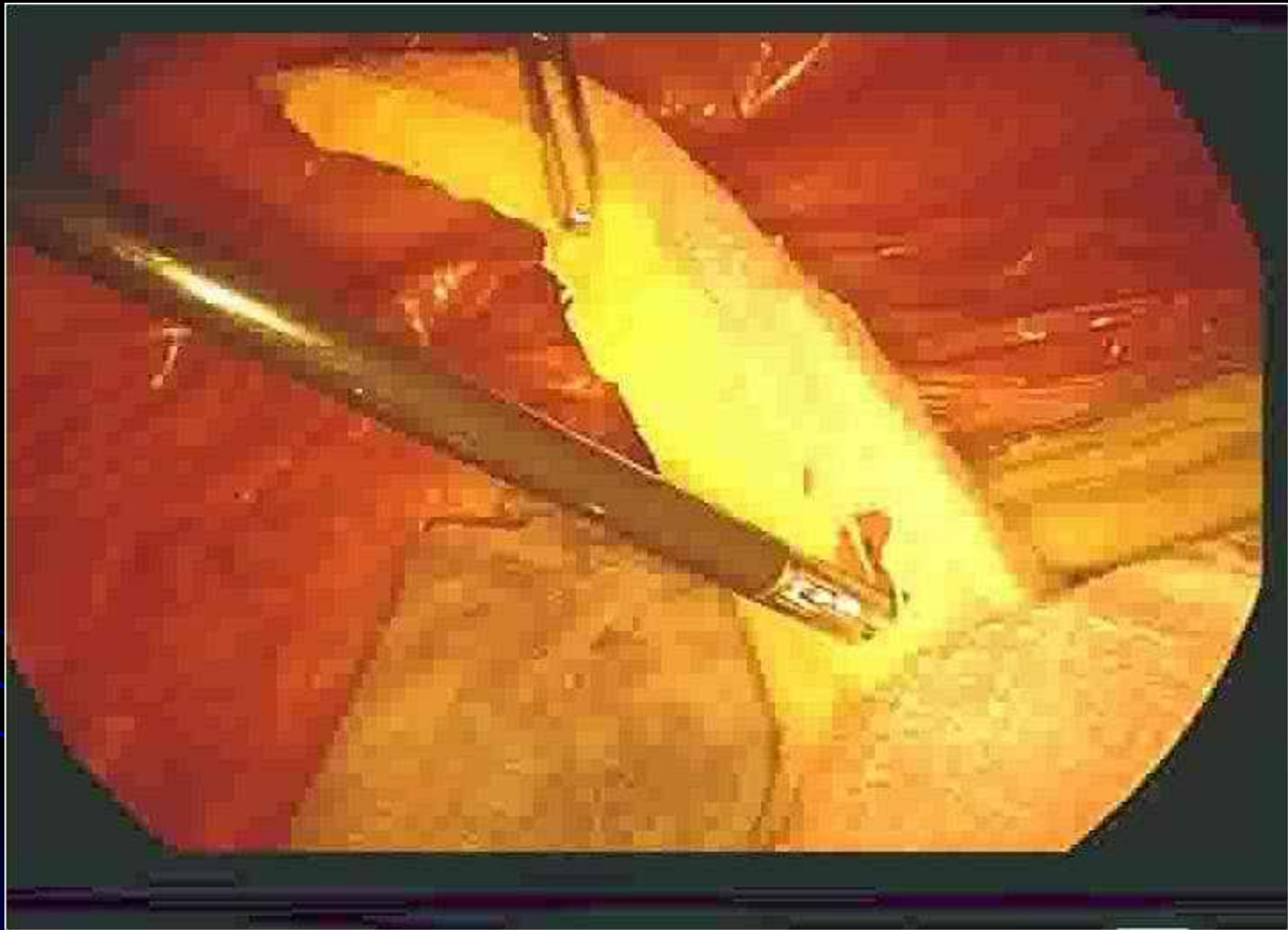














UN Millennium Development Goals

Keep the promise
Millennium Development Goals



Human Anatomical Ultrasound Guide



PRINCIPLES OF
ULTRASOUND



REMOTE GUIDANCE



DATA COLLECTION



CUE CARDS

HEART

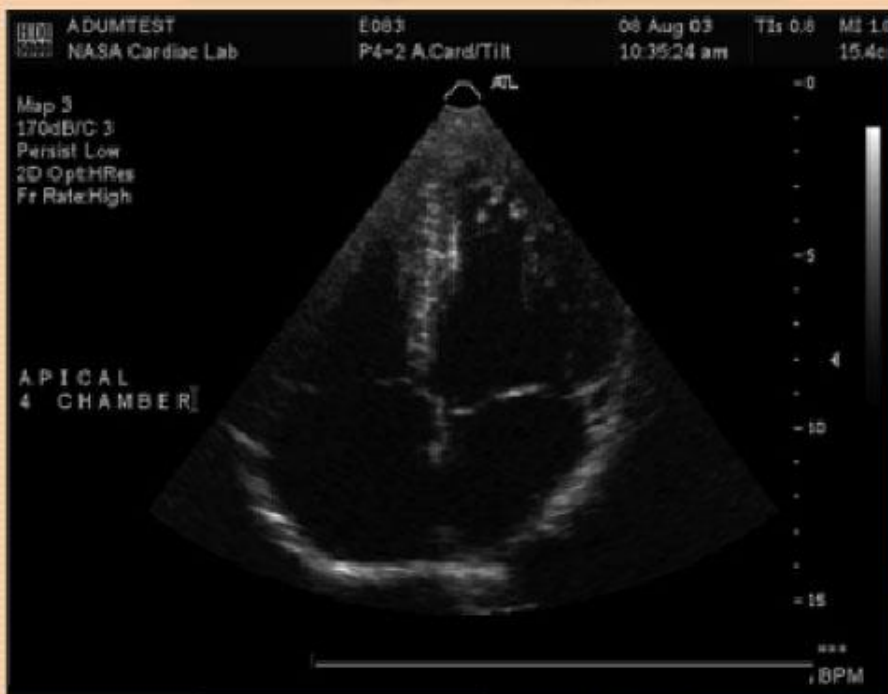
VIEW CUE CARD

Apical	Parasternal	Right Ventricular	Left Ventricular	Subcostal	Short-axis
4-Chamber	Long-axis	Inflow	Short-axis	4-Chamber	Mitral Valve
2-Chamber		Outflow	Long-axis	Short-axis	Aorta
Long-axis				IVC	

Info

Scanning

Pathology



Probe position:

Place probe in C2 position pointing towards the right shoulder with marker to 3 o'clock. Actual position and orientation may vary among subjects. The position/orientation of the heart is also expected to change in OG.





Discussion